# CAMBRIDGE TECHNOLOGY IN MATHS

## *Year 11*

## Introductory probability

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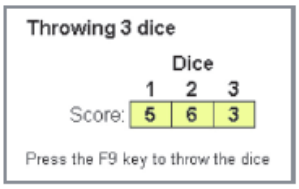
## Using the RAND function in Excel

Dice are random number generators. Such devices are useful resources in the study of probability. Spreadsheets include a random number-generating function which acts as the digital equivalent of dice.

The Excel file on the student disk includes this 'digital dice' feature. Open the 'Throwing dice' spreadsheet and see if you can throw three sixes by pressing the F9 key. It is driven by the RAND function, which generates a random decimal number between 0 and 1, which changes every time the spreadsheet 'calculates'; that is, when anything is entered in a cell or when the F9 key is pressed.




1 What is the probability of throwing three dice and scoring three sixes?

2 Explore the RAND function by entering it into a spreadsheet. (Note that it is unlike most other functions in that it includes a pair of empty brackets which cannot take a cell reference or 'argument'.) Then press the F9 key, which commands the spreadsheet to calculate. Multiplying the result of the RAND function number by 10 or 100 etc., and cutting off the decimal part with the TRUNC function, can produce random integers of one or more digits. The formula =TRUNC(RAND()*10) using these functions will generate a single-digit random number from 0 to 9.

## Creating 100 random numbers in Excel

**Step 1** Use the formula from question 2 above to enter a single-digit random number in cell **B3** of a spreadsheet.

**Step 2** Extend it to generate 100 single-digit random numbers in the range **B3:K12** using the **Fill Down** and **Fill Right** commands. For example, select **B3** and the cells in the column below it, then press **Control-D** for **Fill Down**: the formula is extended to the selected cells which fill with random numbers.

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 Random numbers | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| 3 | | 7 | 2 | 2 | 4 | 2 | 6 | 9 | 8 | 9 | 2 |
| 4 | | 7 | 8 | 3 | 0 | 6 | 1 | 2 | 8 | 0 | 0 |
| 5 | | 3 | 9 | 1 | 6 | 8 | 8 | 5 | 9 | 9 | 9 |
| 6 | | 3 | 8 | 5 | 1 | 9 | 6 | 0 | 2 | 8 | 1 |
| 7 | | 2 | 7 | 7 | 7 | 3 | 6 | 1 | 0 | 7 | 2 |
| 8 | | 3 | 7 | 0 | 2 | 6 | 3 | 9 | 3 | 3 | 4 |
| 9 | | 7 | 7 | 3 | 6 | 4 | 0 | 4 | 7 | 3 | 4 |
| 10 | | 7 | 8 | 6 | 9 | 4 | 5 | 5 | 7 | 9 | 8 |
| 11 | | 9 | 4 | 4 | 3 | 8 | 6 | 0 | 1 | 7 | 9 |
| 12 | | 4 | 5 | 7 | 0 | 6 | 2 | 9 | 3 | 6 | 8 |
| 13 | Digits: | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 14 | Occurences: | 9 | 6 | 10 | 12 | 9 | 5 | 11 | 14 | 11 | 13 |

**Step 3** Now select the entire range **B3:K12** and press **Control+R** (for **Fill Right**). All the other cells are filled with the formula, and so with random numbers.

**Step 4** Label the cells in the range **B13:K13** with the digits 0 to 9. In the row below, starting with **B14**, enter the formula **=COUNTIF($B$3:$K$12,0)**. This formula counts cells in the range **B3:K3** which contain the digit 0. (The **$** symbols ensure the range stays the same.)

**Step 5** Select range **B14:K14** and use **Fill Right**, but then manually adjust the formula in cells **C14:K14** so they count the digit labelled above. This is done by changing the last digit in the formula, so that for **C14** it reads **=COUNTIF($B$3:$K$12,1)**.

The spreadsheet now counts the number of times each digit 0 to 9 occurs in the block of 100 random numbers. The results change each time the **F9** key causes the spreadsheet to re-calculate (called an 'iteration'). The spreadsheet on the student disk has a linked bar graph to display the outcomes.

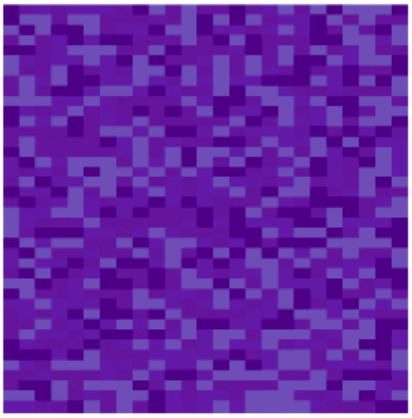
1 What is the probability of the digit 9 occurring in a particular cell in the block of 100 random digits? Is it the same for all digits? How many occurrences of each digit would you expect in the complete block?

2 Press the **F9** key repeatedly to change the random numbers, which is like throwing 100 ten-sided dice. Press the **F9** key 50 times and note the largest and the smallest number of times any digit occurs in the range.

3 Write down what you notice about the outcomes, and whether they were as you expected.

4 Using the '1000 Random Numbers' spreadsheet on the student disk, construct a spreadsheet that will display 1000 random numbers. Compare its outcomes with the 100-number spreadsheet.

## Extension activity: random colours



The Excel file on disk contains a spreadsheet called Random Blue. Explore how it works. To do this you will need to research the **Format Menu> Conditional Formatting** command in Excel, and to look how it's applied to the cells in Random Blue. How are the random number digits effectively hidden? What is the probability that a cell will have the darkest shade of blue on the next iteration?

Use **Edit Menu>Move or copy sheet** to make a copy of Random Blue, and set your own colours in the **Conditional Formatting** command. You could try applying different conditional formatting to different areas of the grid. The conditional formatting feature will also change cell border colours, for instance. Furthermore, you can apply a font such as Wingdings or Webdings, which will display a pictorial symbol rather than a number, if you also change the font colours to contrast with the cell fill colours.

## Answers

### The RAND function

**1** $P_{(\text{three sixes})} = \frac{1}{6} \times \frac{1}{6} \times \frac{1}{6} = \frac{1}{216}$

### 100 random numbers

**1** $P = \frac{10}{100} = \frac{1}{10}$. It is the same for all digits. You should expect 10 occurrences of each digit in the complete block.

**2–4** No fixed answers.

### Extension activity: random colours

The digits are hidden by always having the same colour as the background.

$$P_{(\text{dark blue})} = \frac{\text{2 digits specify dark blue}}{\text{10 digits specify colour}} = \frac{1}{5}$$